

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents  
United States Patent and Trademark  
Office  
Box PCT  
Washington, D.C.20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 21 August 2000 (21.08.00)	
International application No. PCT/EP99/10497	Applicant's or agent's file reference TH 1456 PCT
International filing date (day/month/year) 29 December 1999 (29.12.99)	Priority date (day/month/year) 31 December 1998 (31.12.98)
Applicant TJEENK WILLINK, Cornelis, Antonie et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:

29 June 2000 (29.06.00)

☐ in a notice effecting later election filed with the International Bureau on:2. The election ☒ was☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> : E21B 43/40, B01D 45/16	A1	(11) International Publication Number: WO 00/40835 (43) International Publication Date: 13 July 2000 (13.07.00)
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(21) International Application Number: PCT/EP99/10497

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## (30) Priority Data:

09/223,885	31 December 1998 (31.12.98)	US
09/223,887	31 December 1998 (31.12.98)	US

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(75) Inventors/Applicants (for US only): TJEENK WILLINK, Cornelis, Antonie [NL/NL]; Volmerlaan 8, NL-2288 GD Rijswijk (NL). VAN BERLO, Andre, Olgar, Henry [NL/NL]; Volmerlaan 8, NL-2288 GD Rijswijk (NL).

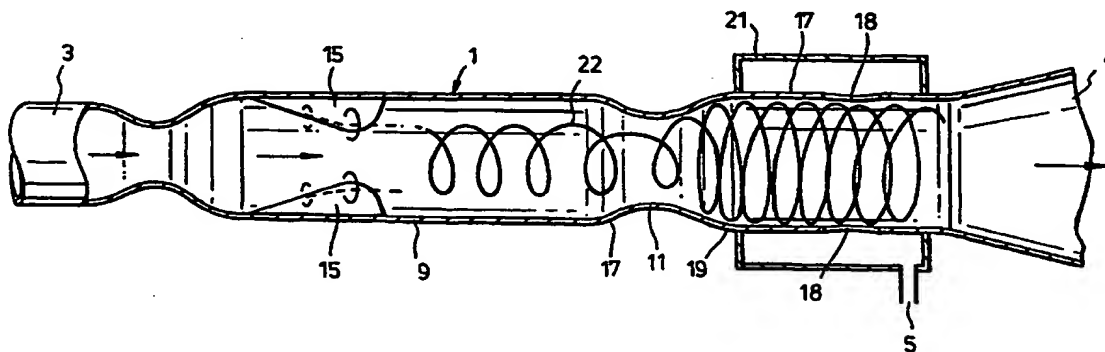
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

## Published

With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD FOR REMOVING CONDENSABLES FROM A NATURAL GAS STREAM



## (57) Abstract

A method for removing condensables from a natural gas stream upstream of a wellhead choke connected to a subterranean formation, the method comprising the steps of: (A) inducing the natural gas stream to flow at supersonic velocity through a conduit and thereby causing it to cool to a temperature that is below a temperature at which condensables will begin to condense forming separate droplets and/or particles; (B) separating the droplets and/or particles from the gases; (C) collecting the gas from which the condensables have been removed; (D) and transporting the gas and/or the condensables to a wellhead and/or re-injecting it into the subterranean formation from which it has been produced, or into a different formation, with the proviso that not all of the collected gas and condensables are re-injected into the same reservoir zone of the same formation, and a well completion system for producing gas from a subterranean formation wherein said method is applied.

Separators that are effective to lower dew points of gases generally require complex equipment and instrumentation, such as refrigerated sponge oils or glycols absorbers. Such operations are generally too complex to be placed at wellheads such as sea floor wellheads, and too expensive to be placed at individual wellheads in a gas producing field.

Downhole separators to remove water from gas as it is being produced are known, for example in US-A-5,444,684. This device uses floating balls that float up and block a flowpath when a water level in the wellbore becomes high, and then as gas pressure builds, and forces the water level down, allowing production of gas that is free of liquid water. This device is only capable of keeping liquid water out of produced gas. It is not capable of removing either condensables or water from the produced gas.

US-A-5,794,697 also discloses a downhole separator for taking gas from a mixture of liquids and gas produced into a wellbore. This patent focuses on downhole compression of the gas and re-injection of the gas into a gas cap over the oil remaining in the formation. A separator is shown and described as an auger that imparts a swirling motion to the fluids, and then removal of the gas from the center of the swirl. This separator also does not lower the dew point temperature of the gas (i.e. remove the condensables), but only separates existing phases.

It would be desirable to have a separator for removing condensables and/or water from a natural gas stream upstream of the wellhead choke, i.e., before entering surface or sub-sea facilities with typical lower pressure ratings in the order of 15 MPa or less. Firstly, this is because a higher pressure drop for separation is still available upstream of the wellhead choke, thereby

WO 99/01194 describes a similar method and corresponding device for removing a selected gaseous component from a stream of fluid containing a plurality of gaseous components. This device is equipped with a shock flow inducer downstream of the collecting zone so as to decrease the axial velocity of the stream to subsonic velocity. Application of a shock wave in this manner results in a more efficient separation of the formed particles.

These references describe various supersonic inertia separators. However, none describe or hint at their use upstream of a wellhead choke of a well completion system, and/or instead of the wellhead choke.

#### SUMMARY OF THE INVENTION

In accordance with the invention there is provided a method for removing condensables from a natural gas stream upstream of a wellhead choke connected to a subterranean formation, the method comprising the steps of:

(A) inducing the natural gas stream to flow at supersonic velocity through a conduit and thereby causing it to cool to a temperature that is below a temperature/pressure at which condensables will begin to condense forming separate droplets and/or particles;

(B) separating the droplets and/or particles from the gases;

(C) collecting the gas from which the condensables have been removed; and

(D) transporting the gas and/or the condensables to a wellhead and/or re-injecting it into the subterranean formation from which it has been produced, or into a different formation, with the proviso that not all of the collected gas and condensables are re-injected into the same reservoir zone of the same formation.

The invention also concerns a well completion system for producing gas from a subterranean formation wherein said method is applied.

#### DETAILED DESCRIPTION OF THE INVENTION

5           Supersonic inertia separators as referred to herein before require a predominantly gaseous stream (i.e. containing less than 10 %wt of either solids or liquids) at sufficient pressure to undergo supersonic acceleration when passing through the converging-diverging Laval  
10       nozzle thereof. Pressures in the well and prior to the wellhead choke can be in the same range as in the subterranean formation, and are normally more than adequate. The method can therefore be used in the wellbore of an unilateral well; in the primary wellbore  
15       or one or more of the branched wellbores of a multilateral wellbore, or instead of the choke of a wellhead. The method can therefore be used on the surface, but also subsurface or sub-sea.

          It will be understood that if the supersonic inertia  
20       separator is used instead of a choke, than in an elegant manner natural gas is freed from condensables at the same time as the reduction in pressure occurs to the level required for a distribution network.

          One of the more attractive advantages of the present  
25       invention concerns the minimum or even lack of moving parts in the supersonic inertia separator, allowing the use thereof at locations that ordinarily require remote controls. The supersonic inertia separator that is preferred, is of the type described in EP-A-0,496,128,  
30       i.e., wherein the supersonic stream containing droplets and/or particles is forced into a swirling motion, thereby causing the droplets and/or particles to flow to a radially outer section of a collecting zone in the stream, followed by the extraction of these droplets  
35       and/or particles in a supersonic collection zone.

one end of the housing, a first outlet 5 for liquid laden fluid near the other end of the housing, and a second outlet 7 for substantially liquid-free fluid at the other end of the housing. The flow-direction in the device 1 is from the inlet 3 to the first and second outlets 5, 7.

The inlet 3 is an acceleration section containing a Laval-type, having a longitudinal cross-section of converging-diverging shape in the flow direction so as to induce a supersonic flow velocity to a fluid stream which is to flow into the housing via said inlet 3. The housing 1 is further provided with a primary cylindrical part 9 and a diffuser 11 whereby the primary cylindrical part 9 is located between the inlet 3 and the diffuser 11. One or more (for example, four) delta-shaped wings 15 project radially inward from the inner surface of the primary cylindrical part 9, each wing 15 being arranged at a selected angle to the flow-direction in the housing so as to impart a swirling motion to fluid flowing at supersonic velocity through the primary cylindrical part 9 of the housing 1.

The diffuser 11 has a longitudinal section of converging - diverging shape in the flow direction, defining a diffuser inlet 17 and a diffuser outlet 19. The smallest cross-sectional flow area of the diffuser is larger than the smallest cross-sectional flow area of the Laval-type inlet 3.

The housing 1 further includes a secondary cylindrical part 17 having a larger flow area than the primary cylindrical part 9 and being arranged downstream the diffuser 11 in the form of a continuation of the diffuser 11. The secondary cylindrical part 17 is provided with longitudinal outlet slits 18 for liquid, which slits 18 are arranged at a suitable distance from the diffuser outlet 19.

layer of liquid which is extracted from the collecting zone via the outlet slits 18, the outlet chamber 21, and the first outlet 5 for substantially liquid. It is, however, also within the spirit of this invention to remove the condensed particles at supersonic velocity, without an upstream shock wave.

The stream from which condensable vapors have been removed is discharged through the second outlet 7 for substantially liquid-free gas.

In Fig. 2 is shown a second embodiment of the device for carrying out the invention. This device has an open-ended tubular housing 23 with a Laval-type fluid inlet 25 at one end and a first outlet 27 for stream containing the solids and any condensed liquid at the other end of the housing. The flow-direction for fluid in the device is indicated by arrow 30. The housing has, from the inlet 25 to the liquid outlet 27, a primary substantially cylindrical part 33, a diverging diffuser 35, a secondary cylindrical part 37 and a diverging part 39. A delta-shaped wing 41 projects radially inward in the primary cylindrical part 33, the wing 37 being arranged at a selected angle to the flow-direction in the housing so as to impart a swirling motion to fluid flowing at supersonic velocity through the housing 23. A tube-shaped second outlet 43 for substantially gas extends through the first outlet 27 co-axially into the housing, and has an inlet opening 45 at the downstream end of the secondary cylindrical part 37. The outlet 43 may be internally provided with a straightened (not shown), e.g. a vane-type straightener, for transferring swirling flow of the gas into straight flow.

Normal operation of the second embodiment is substantially similar to normal operation of the first embodiment. Supersonic swirling flow occurs in the primary cylindrical part 33 and a shock wave, if any,

C L A I M S

1. A method for removing condensables from a natural gas stream upstream of a wellhead choke connected to a subterranean formation, the method comprising the steps of:

5 (A) inducing the natural gas stream to flow at supersonic velocity through a conduit and thereby causing it to cool to a temperature that is below a temperature at which condensables will begin to condense forming separate droplets and/or particles;

10 (B) separating the droplets and/or particles from the gases;

(C) collecting the gas from which the condensables have been removed; and

15 (D) transporting the gas and/or the condensables to a wellhead and/or re-injecting it into the subterranean formation from which it has been produced, or into a different formation, with the proviso that not all of the collected gas and condensables are re-injected into the same reservoir zone of the same formation.

20 2. The method of claim 1, wherein in step B) a swirling motion is induced to the supersonic stream of fluid thereby causing the liquid droplets to flow to a radially outer section of a collecting zone in the stream, followed by the subsonic or supersonic extraction of the  
25 liquids into an outlet stream from the radially outer section of the collecting zone.

30 3. The method of claim 2, wherein in step B) a swirling motion is induced to the supersonic stream of fluid thereby causing the condensables to flow to a radially outer section of a collecting zone in the stream, followed by the subsonic or supersonic extraction of the



condensables into an outlet stream from the radially outer section of the collecting zone.

4. The method of claim 3, wherein the shock wave is created by inducing the stream of fluid to flow through a diffuser.

5. The method of any one of claims 1 to 4, wherein transporting the gases from which the condensables have been removed to a wellhead or different reservoir zone is accomplished through a production tubing, and the condensables or part of the condensables are transported to the surface through a different flowpath.

6. The method of claim 1 wherein water is removed from the gas as a condensable component.

7. A well completion system for producing gas from a subterranean formation comprising a wellhead and a wellbore containing a tubing extending downhole from the wellhead, further comprising a supersonic inertia separator comprising:

an acceleration section wherein gas from the subterranean formation is accelerated to a supersonic velocity;

optionally, a swirl imparting section that imparts a swirling motion to the gas; and

a collection section wherein a gas stream containing reduced amount of condensables is collected.

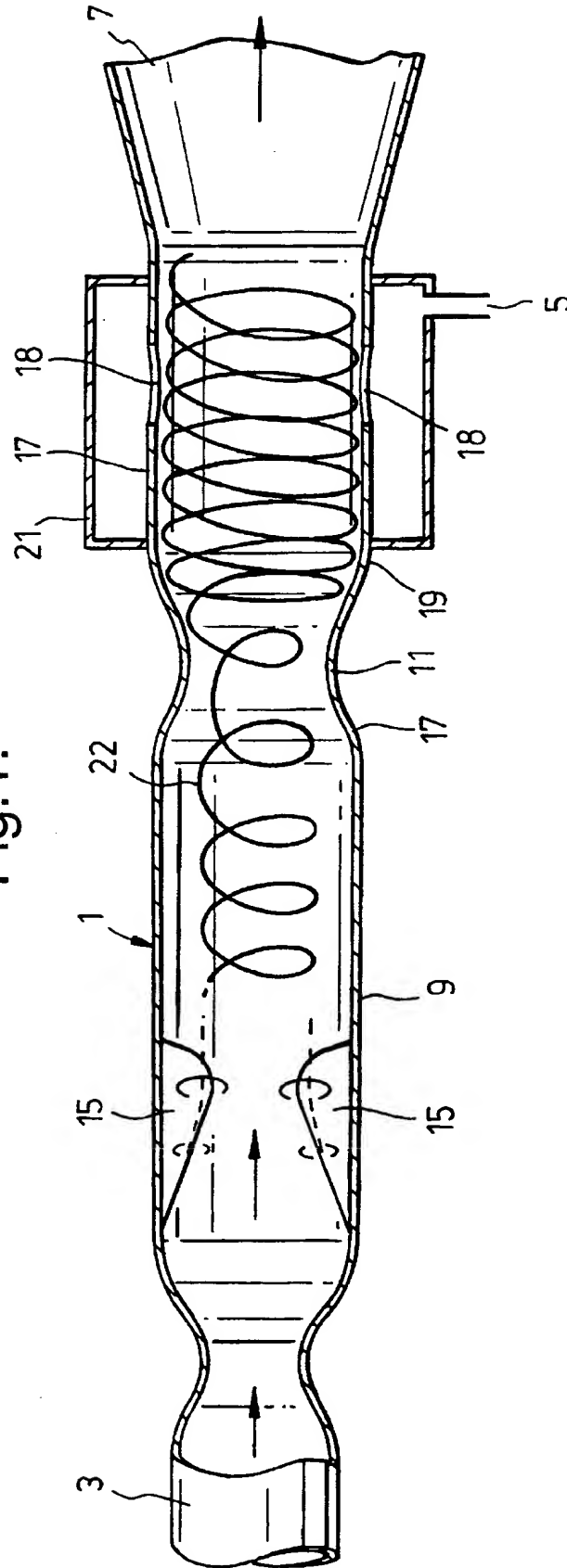
8. A well completion system as claimed in claim 7, comprising a supersonic inertia separator in a wellbore.

9. A well completion system as claimed in claim 7, comprising a supersonic inertia separator at the wellhead.

10. A well completion system as claimed in any one of claims 7 to 9, comprising a multiple branched wellbore system connecting the reservoir of a producing formation with one or more other reservoirs.

11. A well completion system as claimed in any one of claims 7 to 10, further comprising one or more submersible pumps.

Fig.1.



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EE	Estonia	LR	Liberia	SG	Singapore		

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 99/10497

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B43/40 B01D45/16

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 09970 A (ANIL A/S) 13 April 1995 (1995-04-13) claims 1,2	1
A	EP 0 496 128 A (STORK PRODUCT ENGINEERING B.V.) 29 July 1992 (1992-07-29) cited in the application claim 1	1
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 146, 20 March 1990 (1990-03-20) & JP 02 017921 A (MITSUBISHI HEAVY IND LTD), 22 January 1990 (1990-01-22) cited in the application abstract	1



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

25 May 2000

Date of mailing of the international search report

31/05/2000

Name and mailing address of the ISA

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Authorized officer

Bertram, H

# INTERNATIONAL SEARCH REPORT

Information on patent family members

In International Application No

PCT/EP 99/10497

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9509970 A	13-04-1995	NO 933517 A	03-04-1995
		AU 7865094 A	01-05-1995
		CA 2172820 A	13-04-1995
		GB 2297573 A,B	07-08-1996
		NO 961289 A	29-03-1996
		US 5860476 A	19-01-1999
EP 496128 A	29-07-1992	NONE	
JP 02017921 A	22-01-1990	NONE	

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>TH 1456 PCT</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/EP 99/ 10497</b>	International filing date (day/month/year) <b>29/12/1999</b>	(Earliest) Priority Date (day/month/year) <b>31/12/1998</b>
Applicant <b>SHELL INTERNATIONALE RESEARCH et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of Invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1  
☐ None of the figures.

# INTERNATIONAL SEARCH REPORT

National Application No

PCT/EP 99/10497

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B43/40 B01D45/16

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 95 09970 A (ANIL A/S) 13 April 1995 (1995-04-13) claims 1,2	1
A	EP 0 496 128 A (STORK PRODUCT ENGINEERING B.V.) 29 July 1992 (1992-07-29) cited in the application claim 1	1
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 146, 20 March 1990 (1990-03-20) & JP 02 017921 A (MITSUBISHI HEAVY IND LTD), 22 January 1990 (1990-01-22) cited in the application abstract	1

☐

Further documents are listed in the continuation of box C.

☒

Patent family members are listed in annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

25 May 2000

Date of mailing of the international search report

31/05/2000

Name and mailing address of the ISA

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Fax: (+31-70) 340-3016

Authorized officer

Bertram, H



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 99/10497

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9509970 A	13-04-1995	NO 933517 A AU 7865094 A CA 2172820 A GB 2297573 A, B NO 961289 A US 5860476 A	03-04-1995 01-05-1995 13-04-1995 07-08-1996 29-03-1996 19-01-1999
EP 496128 A	29-07-1992	NONE	
JP 02017921 A	22-01-1990	NONE	

## PATENT COOPERATION TREATY

PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 05 APR 2001

WISO

Applicant's or agent's file reference TH 1456 PCT	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/EP99/10497	International filing date (day/month/year) 29/12/1999	Priority date (day/month/year) 31/12/1998
International Patent Classification (IPC) or national classification and IPC E21B43/40		
Applicant SHELL INTERNATIONALE RESEARCH et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 10 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 29/06/2000	Date of completion of this report 02.04.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Georgescu, M Telephone No. +49 89 2399 7502 

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP99/10497

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

### Description, pages:

1,3,4,7-9,11,  
13-22 as originally filed

2,2a,5,6,10,12 as received on 29/01/2001 with letter of 29/01/2001

### Claims, No.:

1-12 as received on 29/01/2001 with letter of 29/01/2001

### Drawings, sheets:

2/6-6/6 as originally filed

1/6 as received on 29/01/2001 with letter of 29/01/2001

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

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4. The amendments have resulted in the cancellation of:

- ☐ the description,      pages:
- ☐ the claims,      Nos.:
- ☐ the drawings,      sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims 1-12
	No: Claims
Inventive step (IS)	Yes: Claims 1-12
	No: Claims
Industrial applicability (IA)	Yes: Claims 1-12
	No: Claims

2. Citations and explanations  
**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

Reference is made to the following documents:

D1: WO 95 09970

D2: EP 0 496 128 A

**V - Reasoned statement under Rule 66.2 (a)(ii)**

**V-1 Claim 1**

D1, which is considered as the closest prior art, describes a method for removing condensables from a natural gas stream (page 2, lines 9-10 and 19-20) upstream of a wellhead choke (fig.1) connected to a subterranean formation (3), using a separator (12) in which droplets and particles are separated from the gases (page 5, lines 4-5) and the gas from which the condensables have been removed is collected (page 5, lines 5-6), wherein the method comprising the steps of:

- (A) introducing the natural gas stream to flow in a separator to condense forming separate droplets and particles (page 5, lines 2-6);
- (B) transporting the gas to the wellhead (page 5, lines 5-6).

The distinguishing features of claim 1 with regard to D1 are:

- 1) the separator used in step (A) is an inertia separator of the type which makes the gas stream "to flow at supersonic velocity **thereby causing it to cool** to a temperature that is below a temperature at which condensables will begin to condense";
- 2) the part of the step (B) "re-injecting it into the ... of the same formation".

The subject-matter of claim 1 is therefore new and the claim meets the novelty requirements of Art. 33(2)PCT.

The method of D1 teaches to introduce the gas stream in a membrane separator (page 5, lines 3-4) in order to separate the condensate **and** unwanted gases ( $H_2S$  and  $CO_2$ ) from the gas **after** it was previously cooled in a separate cooler (16 in fig.2). D1 also discloses that the clean gas obtained after the separation is conveyed to the surface (page 5, lines 5-6) without mentioning any other operation applied to said gas. Even if D2 describes a separator like the one in the

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distinguishing feature 1) of claim 1, D1 does not provide any apparent reason which would determine the skilled man to replace the cooler (16) and the membrane separator (12) by the inertia separator of D2, inverting in a nonobvious way the sequence of cooling the gas and afterwards separating the condensate. Furthermore, the separator of D2 does not provide explicitly also the separation of the  $H_2S$  and  $CO_2$  from the gas stream and there is no evidence that the skilled man would renounce to this advantage of the separator of D1. Thus, it appears that it would not be obvious for the skilled man to combine D1 and D2 in order to arrive to the subject-matter of claim 1. Therefore, claim 1 meets the requirement for inventive step of Art. 33(3) PCT.

**V-2 Claims 2 to 6**

Claims 2 to 6 as dependent claims from claim 1 also meet the requirements of Art. 33 PCT.

**V-3 Claim 7**

As one of the features of the separator (12) used in D1 to separate condensates from the stream of gas is that it is adapted to separate unwanted gases ( $H_2S$  and  $CO_2$ ) and water from the gas stream it would not be obvious for the skilled man to replace in D1 said separator with the separator of D2 which appears not to be adapted to separate said unwanted gases from the gas stream. Therefore claim 7 meets the requirement for inventive step of Art. 33(3) PCT.

**V-4 Claims 8 to 12**

Claims 8 to 12 as dependent claims from claim 7 also meet the requirements of Art. 33 PCT.

**VII - Certain defects**

- VII-1 The expression "inertia separator" in claims 7 and 12 should have been replaced with "inertia supersonic separator" like defined in the description on line 5 on page 6.